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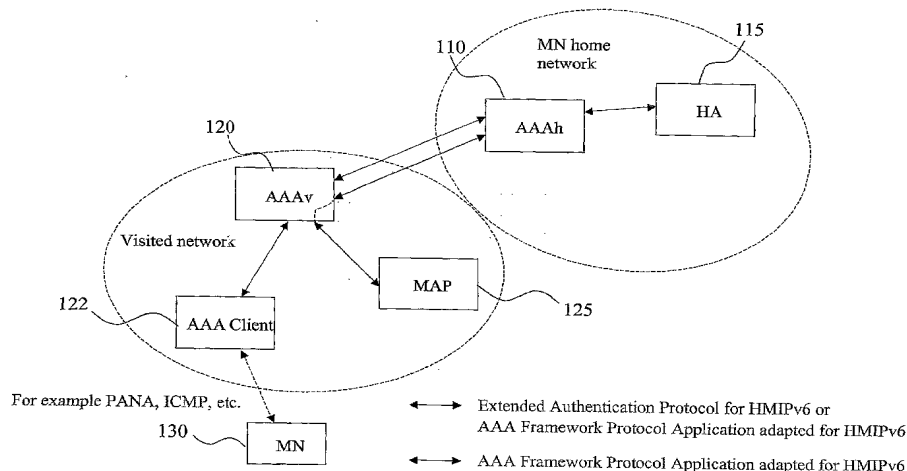
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[Continued on next page]

(54) Title: METHOD, SYSTEM AND APPARATUS TO SUPPORT HIERARCHICAL MOBILE IP SERVICES



(57) Abstract: A basic feature of the invention is to rely on an AAA infrastructure to “bootstrap” the HMIPv6 service for a mobile node (130) that “roams” in a visited network or the home network. In accordance with a preferred embodiment of the invention, bootstrapping the HMIPv6 service involves authenticating and authorizing the mobile node (130) for HMIPv6 service based on an AAA infrastructure. In an important scenario, the mobile node is roaming in a visited network, and the AAA infrastructure (110, 120, 122) links the visited network with the home network of the mobile node. The invention also supports the possibility of having the MAP (125) located in the home network or other network than the visited network. The reliance on the AAA infrastructure preferably involves transferring HMIPv6-related information required for authenticating and authorizing the mobile node for HMIPv6 service over the AAA infrastructure.

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**AMENDED CLAIMS**

[received by the International Bureau on 18 November 2004 (18.11.04);  
original claims 1-51 replaced by new claims 1-58 (11 pages)]

**CLAIMS**

1. A method of supporting Hierarchical Mobile IP version 6 (HMIPv6) service for a mobile node, characterized by using an AAA infrastructure to bootstrap the  
5 HMIPv6 service including:  
said AAA infrastructure assigning an appropriate Mobility Anchor Point (MAP) to the mobile node for the HMIPv6 service; and  
transferring HMIPv6-related information required for authenticating and authorizing the mobile node for the HMIPv6 service with the assigned MAP over said  
10 AAA infrastructure.
2. The method of claim 1, characterized in that an AAA server of said AAA infrastructure assigns an appropriate MAP to the mobile node for the HMIPv6 service.
- 15 3. The method of claim 2, characterized in that the mobile node is roaming in a visited network, and an AAA visited network server (AAAv) assigns a MAP in the visited network to the mobile node.
4. The method of claim 3, characterized in that the AAAv assigns a MAP based  
20 on a policy of the visited network operator.
5. The method of claim 3, characterized in that the mobile node sends a MAP assignment request to an AAA home network server (AAAh) over the AAA infrastructure, and the AAAh forwards the MAP assignment request to the AAA  
25 visited network server (AAAv), and the AAA home network server generates credential-related data for security association between the mobile node and the assigned MAP, said credential-related data being transferred from the AAAh to the MAP via the AAAv, the AAAh generates information for finalizing the security association or the MAP responds with information for finalizing the security  
30 association to the AAAh via the AAAv, and the AAAh sends HMIPv6 authorization

information including MAP assignment information, binding address information and security association information to the mobile node over the AAA infrastructure.

6. The method of claim 2, characterized in that an AAA home network server  
5 (AAA<sub>h</sub>) assigns a MAP in the home network to the mobile node.

7. The method of claim 6, characterized in that the AAA home network server (AAA<sub>h</sub>) generates credential-related data for security association between the mobile node and the assigned MAP and sends said credential-related data to the MAP, the  
10 AAA<sub>h</sub> generates information for finalizing the security association or the MAP responds with information for finalizing the security association to the AAA<sub>h</sub>, and the AAA<sub>h</sub> sends HMIPv6 authorization information including MAP assignment information, binding address information and security association information to the mobile node over the AAA infrastructure.

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8. The method of claim 1, characterized in that an AAA infrastructure component of the home network generates credential-related data for security association between the mobile node and the assigned MAP and sends said credential-related data to the MAP, the AAA infrastructure home network component generates  
20 information for finalizing the security association or the MAP responds with information for finalizing the security association to the AAA infrastructure home network component, which sends HMIPv6 authorization information to the mobile node over the AAA infrastructure.

25 9. The method of claim 1, characterized in that said HMIPv6-related information comprises HMIPv6 authentication, authorization and configuration information.

10. The method of claim 1, characterized by transferring HMIPv6-related information over said AAA infrastructure for establishing a HMIPv6 security association between the mobile node and the assigned MAP.

5 11. The method of claim 10, characterized by transferring HMIPv6-related information over said AAA infrastructure for establishing a HMIPv6 binding for the mobile node.

12. The method of claim 11, characterized by transferring HMIPv6-related  
10 information for HMIPv6 binding in the same round trip as HMIPv6-related information for HMIPv6 security association.

13. The method of claim 1, characterized in that the mobile node is roaming in a visited network, and HMIPv6-related authentication and authorization information is  
15 transferred between the mobile node and an AAA home network server (AAAh) within an authentication protocol in an end-to-end procedure transparent to the visited network.

14. The method of claim 13, characterized in that said authentication protocol is  
20 an extended authentication protocol.

15. The method of claim 14, characterized in that said extended authentication protocol is an extended Extensible Authentication Protocol (EAP), and said HMIPv6-related information is incorporated as additional data in the EAP protocol stack.

25 16. The method of claim 15, characterized in that said HMIPv6-related information is transferred as EAP attributes in the EAP method layer of the EAP protocol stack.

17. The method of claim 15, characterized in that said HMIPv6-related information is transferred in a generic container in the EAP protocol stack.

18. The method of claim 15, characterized in that the extended EAP protocol is  
5 carried by PANA, PPP or IEEE 802.1X between the mobile node and an AAA client in the visited network, and by Diameter or Radius within the AAA infrastructure.

19. The method of claim 1, characterized in that the assigned MAP is located in the home network of the mobile node, and HMIPv6-related information is transferred  
10 between the mobile node and an AAA home network server (AAAh) within an authentication protocol, and HMIPv6-related information is transferred between the AAAh and the assigned MAP in a separate session of the authentication protocol or within an AAA framework protocol application.

15 20. The method of claim 13, characterized in that the assigned MAP is located in the visited network, and HMIPv6-related information is transferred between the mobile node and the AAA home network server (AAAh) within said authentication protocol, and HMIPv6-related information is transferred between the AAAh and the assigned MAP in the visited network within an AAA framework protocol application.

20 21. The method of claim 20, characterized in that said AAA framework protocol application is a Diameter or Radius application adapted for HMIPv6.

22. The method of claim 1, characterized in that said HMIPv6-related  
25 information is transferred in an AAA framework protocol application over said AAA infrastructure.

23. The method of claim 22, characterized in that said AAA framework protocol application is a Diameter or Radius application adapted for HMIPv6.

24. The method of claim 1, characterized by simultaneously accommodating HMIPv6 and MIPv6 authentication and authorization in the same round trip over said AAA infrastructure.

5        25. A system for supporting Hierarchical Mobile IP version 6 (HMIPv6) service for a mobile node, characterized by:

an AAA infrastructure component operable for assigning an appropriate Mobility Anchor Point (MAP) to the mobile node for the HMIPv6 service; and

10        means for transferring HMIPv6-related information required for authenticating and authorizing the mobile node for the HMIPv6 service with the assigned MAP over said AAA infrastructure.

15        26. The system of claim 25, characterized in that said AAA infrastructure component is an AAA server that is operable for assigning an appropriate MAP to the mobile node for the HMIPv6 service.

20        27. The system of claim 26, characterized in that the mobile node is roaming in a visited network, and an AAA visited network server (AAAv) is operable for assigning a MAP in the visited network to the mobile node.

28. The system of claim 27, characterized in that the AAAv is operable for assigning a MAP based on a policy of the visited network operator.

25        29. The system of claim 27, characterized in that an AAA home network server (AAA<sub>h</sub>) comprises:

means for forwarding a MAP assignment request received over said AAA infrastructure from the mobile node to the AAA visited network server (AAAv);

means for generating credential-related data for security association between the mobile node and the assigned MAP;

means for sending said credential-related data to the assigned MAP via the AAAv;

means for receiving, from the MAP via the AAAv, information for finalizing the security association and binding address information; and

5 means for sending HMIPv6 authorization information including MAP assignment information, binding address information and security association information to the mobile node over the AAA infrastructure.

10 30. The system of claim 26, characterized in that an AAA home network server (AAA<sub>h</sub>) is operable for assigning a MAP in the home network to the mobile node.

31. The system of claim 30, characterized in that the AAA home network server (AAA<sub>h</sub>) comprises:

15 means for generating credential-related data for security association between the mobile node and the assigned MAP;

means for sending said credential-related data to the assigned MAP;

means for receiving information from the MAP for finalizing the security association and binding address information;

20 means for sending HMIPv6 authorization information including MAP assignment information, binding address information and security association information to the mobile node over the AAA infrastructure.

32. The system of claim 25, characterized in that an AAA infrastructure component of the home network comprises:

25 means for generating credential-related data for security association between the mobile node and the assigned MAP; and

means for sending said credential-related data to the assigned MAP;

means for receiving information from the MAP for finalizing the security association; and



means for sending HMIPv6 authorization information to the mobile node over the AAA infrastructure.

33. The system of claim 25, characterized in that said HMIPv6-related  
5 information comprises HMIPv6 authentication, authorization and configuration information.

34. The system of claim 25, characterized by means for transferring HMIPv6-  
related information over said AAA infrastructure for establishing a HMIPv6 security  
10 association between the mobile node and the assigned MAP.

35. The system of claim 34, characterized by means for transferring HMIPv6-  
related information over said AAA infrastructure for establishing a HMIPv6 binding  
for the mobile node.

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36. The system of claim 35, characterized by means for transferring HMIPv6-  
related information for HMIPv6 binding in the same round trip as HMIPv6-related  
information for HMIPv6 security association.

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37. The system of claim 25, characterized in that the mobile node is roaming in a  
visited network, and HMIPv6-related authentication and authorization information is  
transferred between the mobile node and an AAA home network server (AAA<sub>h</sub>)  
within an authentication protocol in an end-to-end procedure transparent to the visited  
network.

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38. The system of claim 37, characterized in that said authentication protocol is  
an extended authentication protocol.

39. The system of claim 38, characterized in that said extended authentication protocol is an extended Extensible Authentication Protocol (EAP), and said HMIPv6-related information is incorporated as additional data in the EAP protocol stack.

5        40. The system of claim 39, characterized in that said HMIPv6-related information is transferred as EAP attributes in the EAP method layer of the EAP protocol stack.

10       41. The system of claim 39, characterized in that said HMIPv6-related information is transferred in a generic container in the EAP protocol stack.

15       42. The system of claim 39, characterized in that the extended EAP protocol is carried by PANA, PPP or IEEE 802.1X between the mobile node and an AAA client in the visited network, and by Diameter or Radius within the AAA infrastructure.

20       43. The system of claim 25, characterized in that the assigned MAP is located in the home network, and HMIPv6-related information is transferred between the mobile node and an AAA home network server (AAAh) within an authentication protocol, and HMIPv6-related information is transferred between the AAAh and the MAP in a separate session of the authentication protocol or within an AAA framework protocol application.

25       44. The system of claim 37, characterized in that the assigned MAP is located in the visited network, and HMIPv6-related information is transferred between the mobile node and an AAA home network server (AAAh) within said authentication protocol, and HMIPv6-related information is transferred between the AAAh and the assigned MAP in the visited network within an AAA framework protocol application.

30       45. The system of claim 44, characterized in that said AAA framework protocol application is a Diameter or Radius application adapted for HMIPv6.

46. The system of claim 25, characterized in that said HMIPv6-related information is transferred in an AAA framework protocol application over said AAA infrastructure.

5        47. The system of claim 46, characterized in that said AAA framework protocol application is a Diameter or Radius application adapted for HMIPv6.

10       48. The system of claim 25, characterized by means for simultaneously accommodating HMIPv6 and MIPv6 authentication and authorization in the same round trip over said AAA infrastructure.

15       49. An AAA server for supporting Hierarchical Mobile IP version 6 (HMIPv6) service for a mobile node, characterized by means for assigning an appropriate Mobility Anchor Point (MAP) to the mobile node for the HMIPv6 service.

50. The AAA server of claim 49, characterized in that the mobile node is roaming in a visited network, and said AAA server is an AAA visited network server (AAAv) operable for assigning a MAP in the visited network.

20       51. The AAA server of claim 50, characterized in that said AAAv is operable for assigning a MAP based on a policy of the visited network operator.

25       52. The AAA server of claim 49, characterized in that said AAA server is an AAA home network server (AAAh) operable for assigning a MAP in the home network of the mobile node.

53. The AAA server of claim 49, characterized in that said MAP assigning means operates in response to a MAP assignment request initiated from the mobile node.

54. The AAA server of claim 49, characterized in that said MAP assigning means is operable for performing network-initiated MAP assignment.

55. An AAA home network server (AAAh) for supporting Hierarchical Mobile  
5 IP version 6 (HMIPv6) service for a mobile node, characterized by:

means for generating credential-related data for security association between the mobile node and a Mobility Anchor Point (MAP) assigned by an AAA infrastructure component; and

means for sending said credential-related data to the assigned MAP;

10 means for receiving information from the MAP for finalizing the security association; and

means for sending HMIPv6 authorization information including security association information to the mobile node.

15 56. The AAA home network server of claim 55, characterized in that said mobile node is roaming in a visited network, and said means for sending HMIPv6 authorization information is operable for sending the information over an AAA infrastructure linking the visited network with the home network of the mobile node.

20 57. The AAA home network server of claim 56, characterized in that said AAA home network server is configured for receiving, from the assigned MAP, information for finalizing the security association as well as binding address information, and said means for sending HMIPv6 authorization information over the AAA infrastructure is configured for sending HMIPv6 authorization information including MAP assignment  
25 information, binding address information and security association information to the mobile node.

58. A system for supporting Hierarchical Mobile IP version 6 (HMIPv6) service for a mobile node, characterized by means for transferring HMIPv6-related  
30 authentication and authorization information in an Extensible Authentication Protocol

(EAP) between the mobile node and an AAA home network server over an AAA infrastructure for authenticating and authorizing the mobile node for HMIPv6 service, said HMIPv6-related information being incorporated as additional data in the EAP protocol stack.

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